LISBON FALLS DAM

ME-00004

LOW HAZARD

State ID# 00103

NATIONAL DAM INSPECTION PROGRAM
CORPS OF ENGINEERS

HALEY & ALDRICH, INC.
238 MAIN STREET · CAMBRIDGE · MASSACHUSETTS 02142
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24 January 1980
File No. 4454

Department of the Army
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Attention: Mr. E.P. Gould, Project Manager

Subject: National Dam Inspection Program
Contract No. DACW33-80-C-0009, Item 11

Gentlemen:

The Lisbon Falls Dam, Identification No. ME 00004, has been found to have a "low" hazard potential based on our site examination on 9 November 1979 and subsequent calculations and evaluations. This finding has brought to the attention of your Mr. E.P. Gould of Project Management by our letter dated 3 January 1980. In accordance with the contract agreement, this letter report documenting the "low" hazard potential classification of the dam is submitted in lieu of a complete Phase I Investigation report.

The Lisbon Falls Dam is a run-of-the-river dam located on the Androscoggin River in Lisbon Falls, Maine, Androscoggin County, as shown on the Location Map, page A-1. At this location on the Androscoggin, the river forms the boundary between the Towns of Durham and Lisbon, Maine. The dam is reported to have been built in 1880. No design data for the dam were located and none are believed to exist.

Lisbon Falls Dam has two main sections of earth filled timber crib spillway on bedrock. The length of dam is reported to be 914 ft. and it has a hydraulic height of approximately 25 ft. to the platform above the spillway at the left abutment. The right section of the spillway is estimated to be 400 ft. long and is approximately 40 in. higher than the left section. The two sections are separated by a large rock outcrop located in about the middle of the river. The left section of the spillway is estimated to be 250 ft. long

and has wooden flashboards affixed to it in winter. The spillway abuts a rock outcrop on the right end and a textile mill belonging to the Max Miller & Co., Inc. on the left.

Adjacent and to the left of the textile mill there is a hydroelectric power house built in 1920. At the intake, water is screened through a wooden trash rack from a forebay and flows directly to four gates which convey the water to three turbines. At the discharge water is conducted by an approximately 500 ft. long tailrace that returns the flow to the Androscoggin River. Max Miller & Co., Inc. uses the power house to produce a portion of the textile mill's electricity needs. During periods of low flow the power generating facilities are shut down to maintain the water level at the top of the spillway crest.

Six photographs taken of the dam and appurtenant structures during the site examination on 9 November 1979 are appended to this report.

Based on the Corps of Engineers Guidelines for Estimating Dam Failure Hydrographs, and assuming that a failure would occur along 25 percent of the mid-height length of the dam structure, the peak failure outflow is estimated to be 75,400 cfs. The peak failure outflow represents a 15 percent increase over the base flood flow of 65,700 cfs which would be occurring prior to failure with the Androscoggin River stage at top of dam. The estimated increase in river stage immediately downstream of the dam as a result of a failure would be approximately 1.5 feet.

Routing of the peak failure surge downstream approximately 3.3 miles to the Pejepscot Dam results in a peak surge flow of 72,400 cfs. Pejepscot Dam discharge capacity with water at top of dam is 66,500 cfs. A failure surge of 72,400 cfs would overtop the dam by approximately 9 inches. The Androscoggin River flow occurring prior to failure (65,700 cfs) is equivalent to a 10-year flood at the Pejebscot Dam. The dam failure surge of 72,400 cfs is equivalent to a 15-year flood. Existing development along the Androsocggin River between the Lisbon Falls and Pejepscot Dams is generally at or above the limits of the 100-year flood plain. Although a failure of Lisbon Falls Dam might cause some damages and economic losses, particularly at the Pejepscot Dam power generating facilities, there does not appear to be any significant potential for loss of life. There is no development downstream of the Pejepscot Dam along the Androscoggin River for approximately 4 miles which would be affected by a failure of the Lisbon Falls Dam. Beyond this point, little if any affects of a failure would be seen in the river.

It is of interest to note that there have been three historical floods which were equal to or greater than the top of dam failure flood of 65,700 cfs. The greatest flood of record occurred on March 20, 1936 having a peak discharge of 135,000 cfs. This flood overtopped the Lisbon Falls Dam by approximately 4 ft. and the tailwater was about 6.5 ft. above the crest of the spillway.

Therefore, it is concluded that the hazard potential at the Lisbon Falls Dam site is "low". Because of this finding, the Phase I report of the condition of the dam will not be completed.

Very truly yours,
HALEY & ALDRICH, INC.

Peter L. LeCount
Vice President

PLL/bms
Enclosures

DAM: Lisbon Falls

IDENTIFICATION NO. ME 00004

N

LOCATION MAP

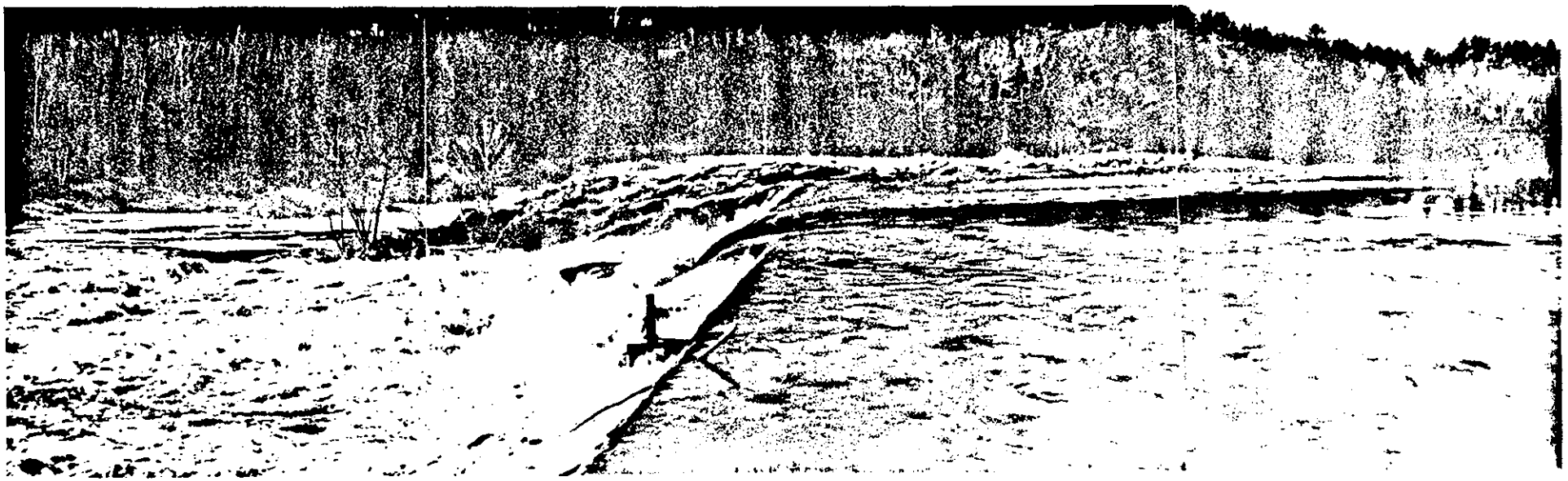
U.S.G.S. QUADRANGLE

FREEPORT, ME

APPROX. SCALE: 1"= 1 MILE

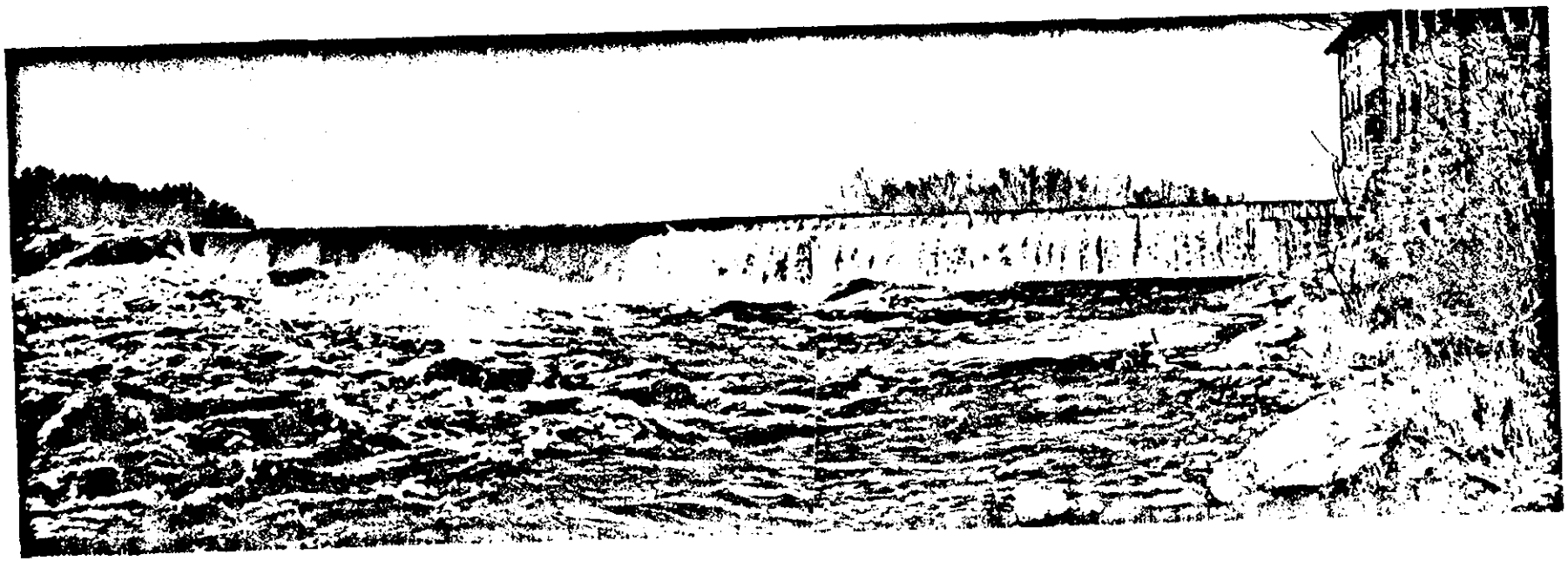
FILE NO. 4454 A9

1. Overview of Lisbon Falls Dam showing downstream side

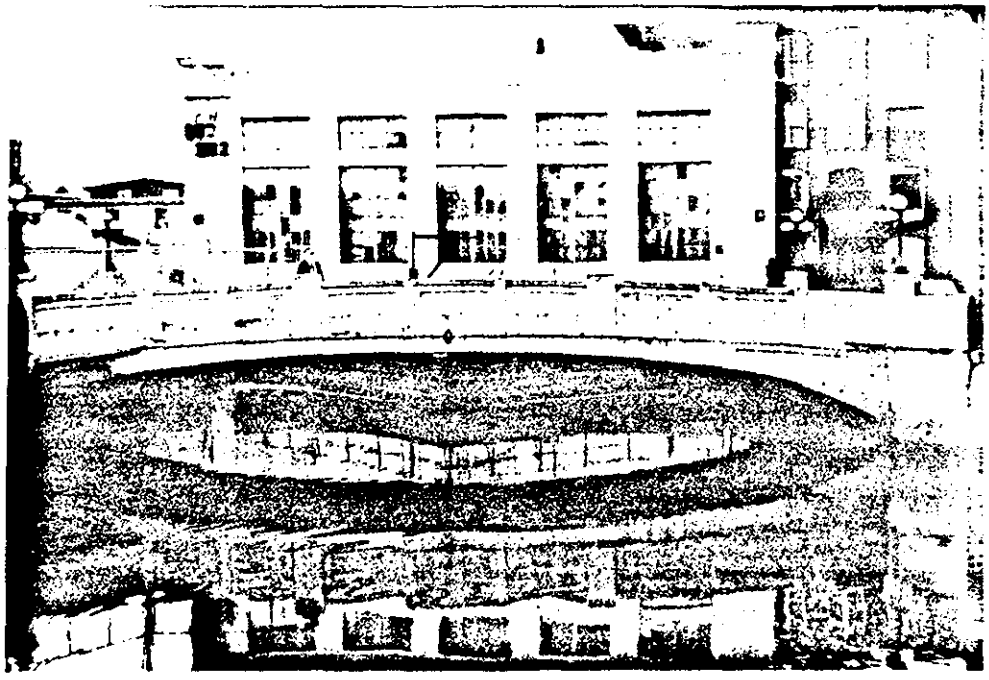


2. Alignment of dam from textile mill

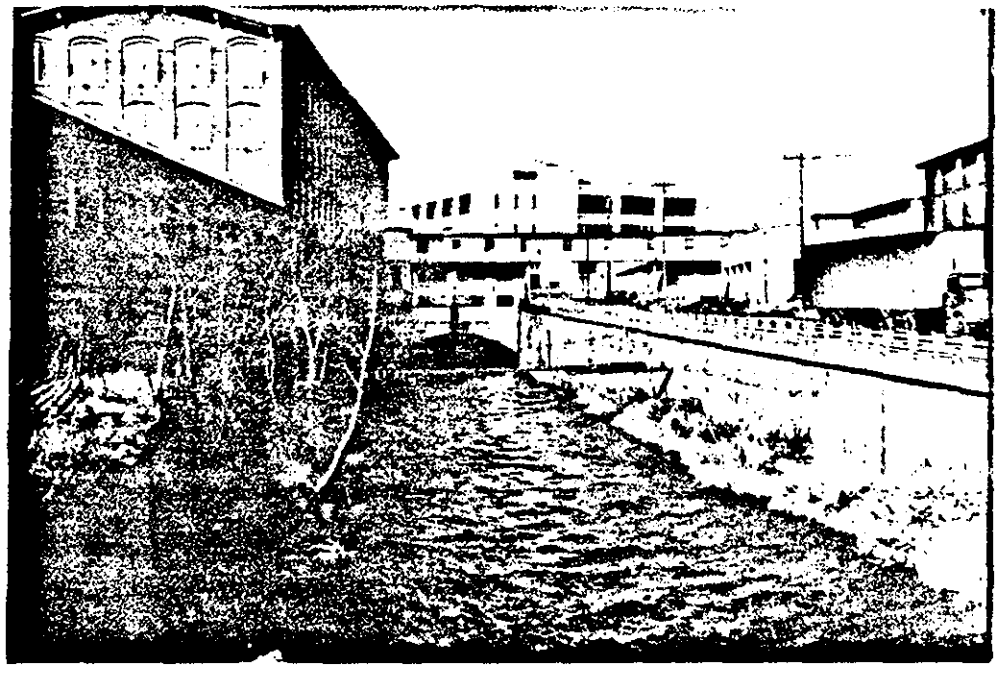
3. Right side, downstream



4. Left side, downstream



5. Forebay and power house intake



6. Tailrace and backside of power house

DAM FAILURE ANALYSIS

Length of Dam & Spillway = 914 ft., Est. mid-height length = 400 ft.
Crest Elev. 96.9
Top of Dam Elev. 104.7 Right abutment; left abutment is higher
Toe of Dam Elev. 80.0
Drainage Area: 3,370 sq. mi. *

*From Flood Plain Information Report (FPI) for Lisbon and Durham, ME dated Feb. 1978, the following info. is presented: (see page D-6)

FLOOD FREQ.	FLOW (cfs)	HEADWATER ELEV.	TAILWATER ELEV.
10-YR	64,000	-	-
50-YR	96,000	-	-
100-YR	114,000	108.2	98 ±
500-YR	160,000	111.2	103.5 ±

$Q = CLH^{3/2}$ or $C = Q/LH^{3/2}$

"C" for 100-YR flood w/~1' crest submergence is 3.28
"C" for 500-YR flood w/~6.5' " " " 3.24

∴ assume "C" = 3.3 for spillway discharge with river at top of dam and no submergence

∴ $Q_S = 3.3 \times 914 \times (104.7 - 96.9)^{1.5} = 65,700$ cfs

Assume breach involves 25% of the mid-ht. length of the dam.

Then $Q_f = 8/27 \sqrt{32.2} \times (400 \times 0.25)(104.7 - 80)^{1.5} = 20,640$ cfs

Adjust Q_f to account for tailwater:
Tailwater for normal flow (6,100 cfs) = El. 88.0
" " 100YR " (114,000 cfs) = El. 98.0

then tailwater prior to failure (Q = 65,700 cfs):

$[(98-88)/(114,000-6,100)] \times (65,700-6,100) + 88 = El.\ 93.5$

$Q_f = 20,640\left[1-\left(13.5/24.7\right)^{1.5}\right]^{0.385} = 16,900$ cfs

Flow over non-failed sect. = $3.3 \times (914-100)(104.7-96.9)^{1.5} = 58,500$ cfs

∴ Combined flow @ failure = 58,500 + 16,900 = 75,400 cfs

The Rejepscot Dam is located approx. 3.3 miles downstream of the Lisbon Falls Dam. To determine the impact of a failure of the Lisbon Falls Dam on the Rejepscot Dam, the dam failure surge must be routed.

Storage u/s of Lisbon Falls Dam below spillway Crest:

800 ac-ft normal } NED Inventory
1000 ac-ft max. }

Determine Stage - Discharge - Surcharge Storage Relationships for d/s river channel:

Refer to page D-8 (Plate 11) from FPI report for typical d/s cross section (SECTION 5)

Normal Stage: El. 65.0 at 6,100 cfs }
100-YR Stage: El. 82.0 at 114,300 cfs } $(114,300-6,100)/(82-65)$
$= 6,365$ cfs/ft.

D/S River stage prior to failure (base flow):

$(65,700-6,100)/6,365 + 65 =$ El. 74.4

Route Dam Failure Outflow Surcharge d/s to Rejepscot Dam:

Reach 1 - 10,000 ft. d/s of dam

$Q_{P2}' = Q_{P1}(1 - Y_1/S)$

$Q_{P1} = 75,400 - 65,700 = 9,700$ cfs
SURCH. above base flow = $9,700/6,365 = 1.5$ ft.
$Y_1 = [600'(\text{width}) \times 10,000'(\text{length}) \times 1.5'(\text{depth})] \div 43,560$ ft²/a
$= 207$ ac-ft.
$Q_{P2}' = 9,700(1-207/1000) = 7,700$ cfs
$Y_2 = [(7,700/6365) \times 600' \times 10,000] \div 43,560 = 167$ ac-ft.
$V_{avg} = (167 + 207)/2 = 187$ ac-ft.

$Q_{P_2}' = 19,700\,(1 - 187/1000) = 17,900$ cfs

$\therefore Q_{P_2} = 17,900 + 65,700 = 73,600$ cfs

Reach 2 - 7,400 ft (Pejepscot Dam)

$Q_{P_2}' = 7,900$ cfs

$V_1 = [(7,900/6365) \times 800' \times 7,400'] \div 43,560 = 169$ ac-ft.

$Q_{P_T}' = 7,900\,(1 - 169/1000) = 6,560$ cfs

$V_2 = [(6,560/6365) \times 800' \times 7400'] \div 43,560 = 1140$ ac-ft.

$V_{avg.} = (140 + 169)/2 = 154.5$ ac-ft.

$Q_{P_3}' = 7,900\,(1 - 154.5/1000) = 6,700$ cfs

$\therefore Q_{P_3} = 6,700 + 65,700 = 72,400$ cfs

Find stage at Pejepscot Dam:

$H = [72,400/(3.3 \times 430)]^{2/3} = 13.75$ ft.

freeboard to top of dam = 13 ft.

$\therefore$ dam overtopped by 9 inches of water

Window sill elev. of power generating bld'g on left bank is approx. 2 ft. above top of dam and $\therefore$ above W.S. elev. resulting from failure of Lisbon Dam.

Frequency-Discharge Relationships at Durham-Brunswick Corp. Limits (approx. mid-way between Lisbon and Pejebscot Dams):

YEAR	FLOW (cfs)	
10	64,210	← 65,700 cfs prior to failure
15	71,200	← 72,400 cfs at Pejepscot
20	77,000	after failure of Lisbon Falls
30	85,500	
50	96,320	
100	114,380	

Review of USGS Quads (Freeport, Me - 1957 & Bath, Me - 1957) together with field observations indicate that there is no existing development which would present a potential for loss of life in the event of a failure of Lisbon Falls Dam.

It is worthwhile to note also that there have been 3 recorded floods which were equal to or greater than the base flood (water at top of dam) of 65,700 cfs.

March 1896 - 65,000 cfs at Auburn Gage
March 28, 1953 - 95,800 cfs " " "
March 20, 1936 - 135,000 cfs " " "

The flood of March 1936 overtopped the dam by approx. 4 ft. and the tailwater submerged the spillway crest by 6.5 ft.

In the event that the dam were to fail during a flood greater than that used for the above analysis (water at top of dam ≈ 10-YR flood), the impact would be even less significant as the failure surge would be a lesser percent of the base flood occurring prior to failure.

∴ Hazard Classification is "LOW"

Attachments from the FPI Report are:

page 11, TABLE 4: Flood Discharge Data	A-11
page 14, TABLE 5: Peak Flood Flows	A-12
page 17, TABLE 6: Elevation Data	A-13
portion of Plate 6: Flooded Areas	A-14
portion of Plate 9: High Water Profiles	A-15
Plate 11: Typical Cross Sections	A-16

PAST FLOODS

Summary of Historical Floods

Records of floods on the Androscoggin River extend back as far as January 1770 when floods are reported to have washed out many mills and dams owing particularly to the heavy ice going out. Records of floods in the study area are limited. The nearest discharge records are available at the USGS gage in Auburn which was established in 1928. The zero of the gage is at 109.18. The ten highest recorded discharges at this location are listed in Table 4.

TABLE 4
FLOOD DISCHARGE DATA
AUBURN, MAINE

Date of Crest	Peak Discharge cfs		Stage Feet
March 20, 1936	135,000		27.57
March 28, 1953	95,800		22.84
March 1896	65,000	(estimated)	Approx. 18.00
December 22, 1973	60,000		16.78
April 4, 1951	52,900		15.26
November 9, 1963	52,600		15.21
October 26, 1959	51,500		14.90
April 22, 1950	50,800		14.76
September 12, 1954	49,600		14.50
April 24, 1958	46,700		13.87

Flood Records

Information on historical floods on the Androscoggin River were obtained from records of USGS gaging station in Auburn. High water marks of past floods were obtained, residents along the stream were interviewed and newspaper files and historical documents were searched for information concerning past floods.

Flood Descriptions

Historical notations of flooding on the Androscoggin River have been recorded since colonial times. Following are descriptions of some known large floods on the Androscoggin River.

TABLE 5
PEAK FLOOD FLOWS
Flow in cubic feet per second

Flood	Durham-Brunswick Townline	Worumbo Mill Dam Lisbon Falls	Auburn City Durham Town Boundaries
500-year Flood	160,700	160,000	153,800
100-year Flood	114,380	114,000	109,200
50-Yr. Flood	96,320	96,000	93,300
10-Yr. Flood	64,210	64,000	62,600

It should be noted that the flood profiles and flooded areas shown on the plates included in this report are based on adopted values of flood discharges and stream channel and flood plain conditions as they existed at the time of this study. They may not, therefore, agree with reputed high water marks from previous floods of an estimated magnitude. For example, existing bridges and highway embankments crossing flood plains have been assumed to remain intact, whereas during previous floods they may have been destroyed or breached. In such cases, the computed flood elevations would differ from the observed flood elevations for floods of similar magnitude.

The 100-year and 500-year Floods defined above were determined by hydrologic studies based on sound engineering judgment and procedure. However, it is noted that future flood stage and discharge frequencies in the study area will depend partly on the unpredictable acts of man rather than the probability of meteorological events. Serious flooding may occur at any time due to the result of clogging with debris or collapse of the dam or bridge. Encroachment on natural storage areas will increase flood discharges and stages due to the increased runoff rates from the developed areas, the loss of temporary ponding space, and the possible restriction of the floodway. The hydrologic information reported herein is considered representative under existing conditions in the study area and under reasonable future levels of development.

The relative water surface elevations for the 100-year Flood and the 500-year Flood are shown on Plates 7,8,9, and 10.

Rates of rise and duration of flooding - The drainage area of the Androscoggin River at Lisbon Falls plays a major role in flood rates and duration in the Lisbon area. Since upper drainage areas of the Androscoggin River are many miles to the north, several days may pass before effects of heavy rains cause peak flows in the study reach. In the same manner, severe flood conditions may persist for as much as a week after peak flows occur while reservoirs, lakes, and large tracts of land in the northern Androscoggin River Basin return to normal levels.

TABLE 6
ELEVATION DATA
Bridge on the Androscoggin River

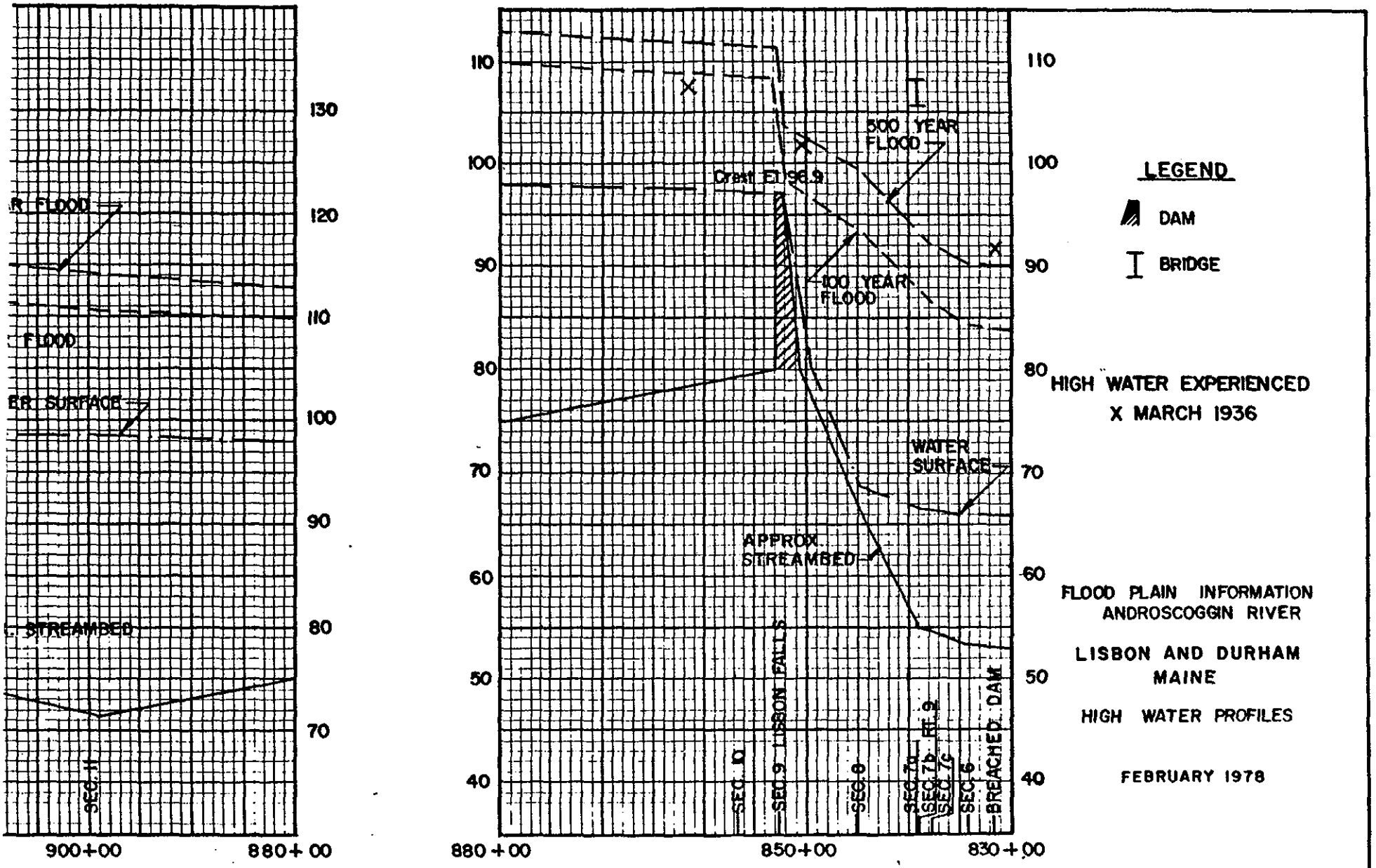
Identification	Station (a) Above Mouth	Under-clearance Elevation ft. msl	Water Surface Elevation 100-year Flood ft. msl	Water Surface Elevation 500-year Flood ft. msl
Lisbon Falls	839+00	105.4	87.5	93.0

(a) distance in feet above mouth of Androscoggin River to nearest 100 feet.

TABLE 7
ELEVATION DATA
Dam on the Androscoggin River

Identification	Station (a) Above Mouth	Crest Elevation ft. msl	Water Surface Elevation 100-year Flood ft. msl	Water Surface Elevation 500-year Flood ft. msl
Worumbo Mill Dam	853+00	96.9	108.2	111.2

Photographs, Future Flood Heights - The levels that the 100-year and 500-year floods are expected to reach at various locations along the Androscoggin River are indicated on the following photographs, Figures 8-10.



OUTH OF ANDROSCOGGIN RIVER

FLOOD PLAIN INFORMATION
ANDROSCOGGIN RIVER

LISBON AND DURHAM
MAINE

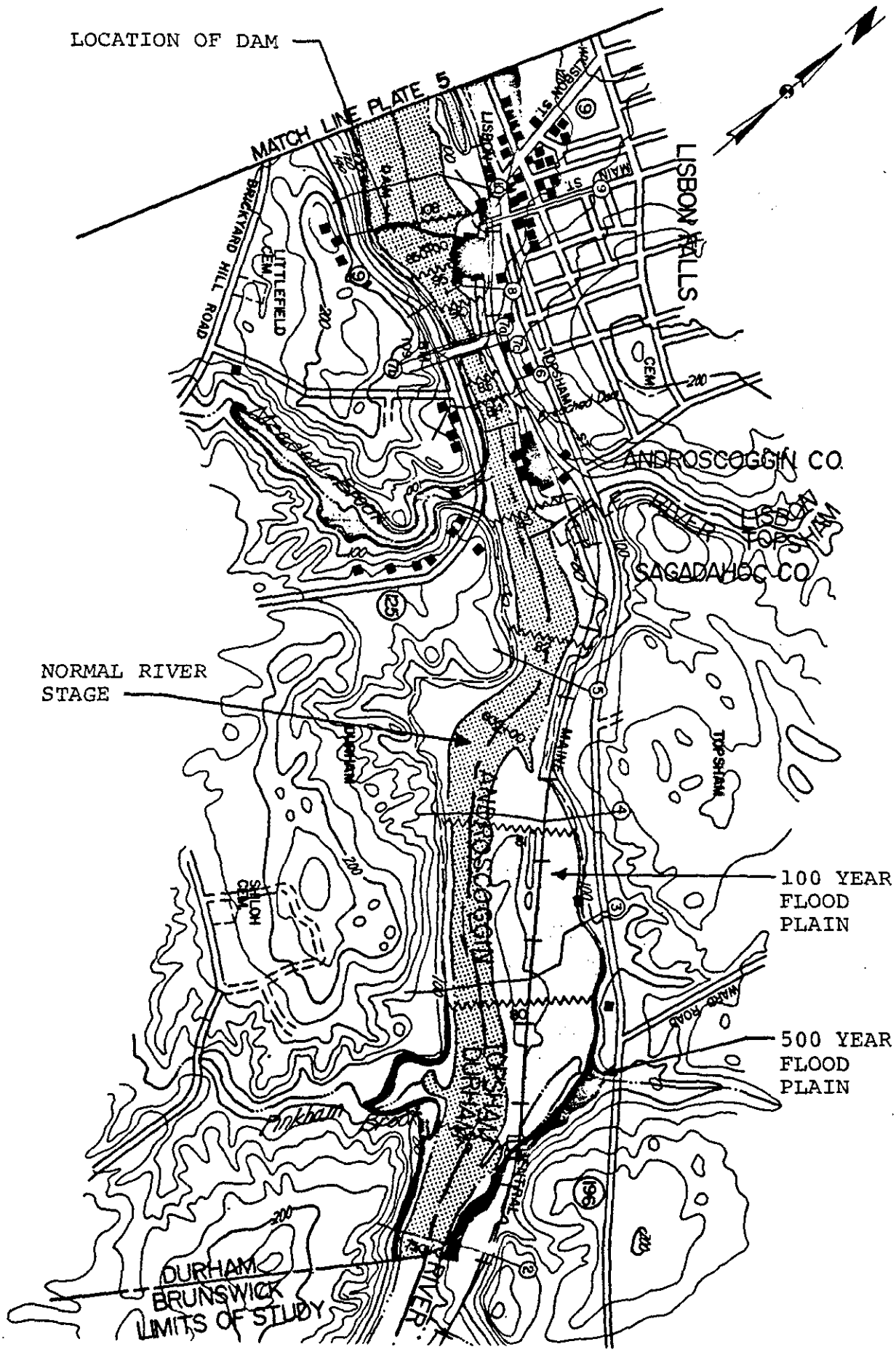
HIGH WATER PROFILES

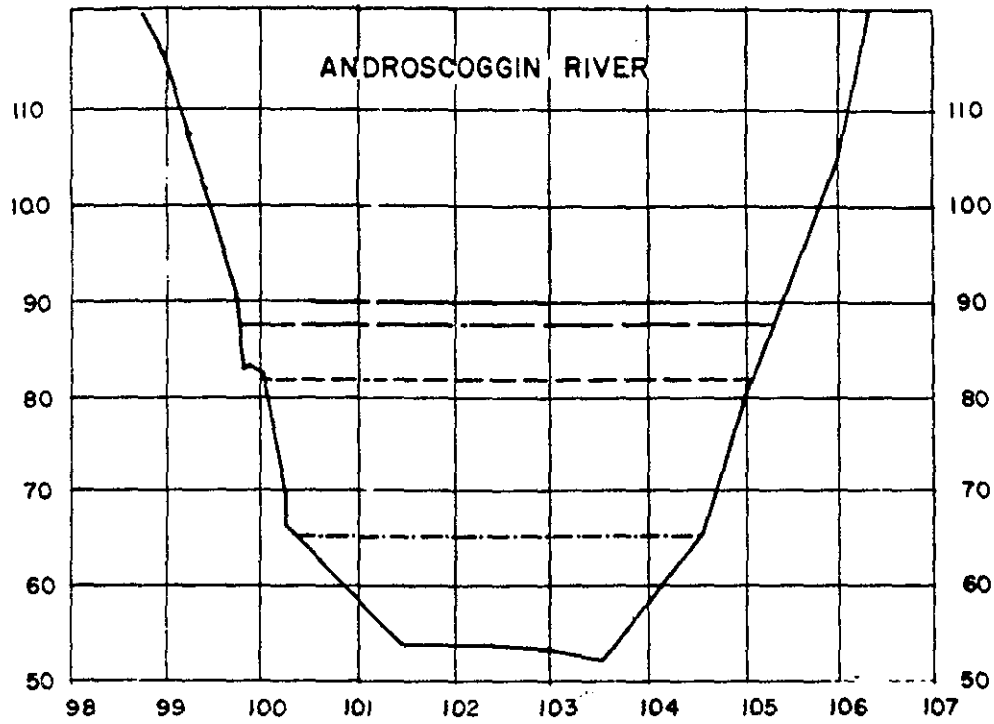
FEBRUARY 1978

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE 9

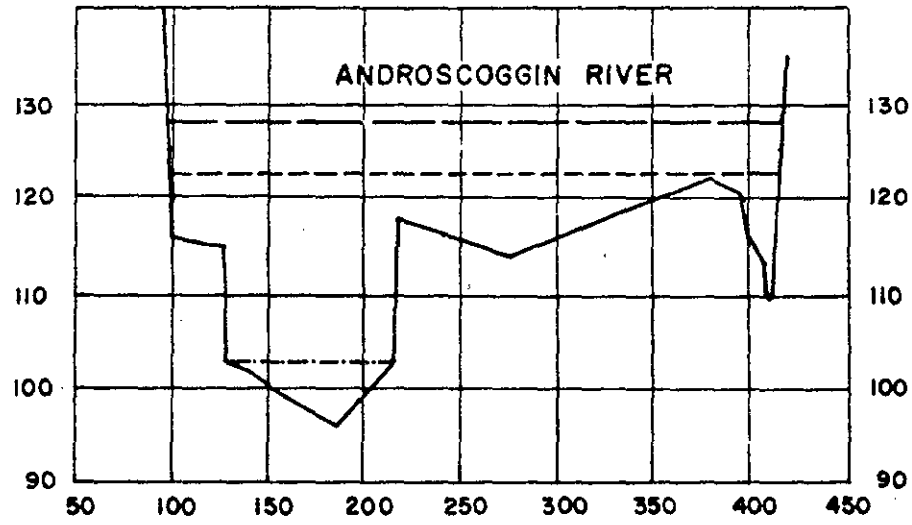
A-1,


LOCATION OF DAM
MATCH LINE PLATE 5
LISBON FALLS
ANDROSCOGGIN CO.
SAGADAHOC CO.
NORMAL RIVER STAGE
100 YEAR FLOOD PLAIN
500 YEAR FLOOD PLAIN
DURHAM
BRUNSWICK
LIMITS OF STUDY
LITTLEFIELD CEM.
MAPLE ROAD
MAIN ST.
LISBON ST.
TOPSHAM
DURHAM
ANDROSCOGGIN RIVER



SECTION 5

Section shown 1350' below confluence of Little River



SECTION 20

Section shown 1800' upstream of Gerrish Brook

NOTES

1. SECTION TAKEN LOOKING DOWNSTREAM
2. HORIZONTAL DISTANCES IN FEET
3. ELEVATIONS IN FEET (mean sea level datum)

LEGEND

——— 500 YEAR FLOOD
– – – – 100 YEAR FLOOD
—·—·— WATER SURFACE

FLOOD PLAIN INFORMATION
ANDROSCOGGIN RIVER
LISBON AND DURHAM, MAINE

TYPICAL CROSS SECTIONS

FEBRUARY, 1978
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

PLATE II

PART I – INVENTORY OF DAMS IN THE UNITED STATES

(PURSUANT TO PUBLIC LAW 92-367)

See reverse side for instructions.

[1]

STATE	IDENTITY NUMBER				
1 2	3	4	5	6	7
ME	0	0	0	0	4

[2] [3] [4] [5] [6] [7] [8] [9] [10] [11] [12]

IDENTIFICATION

DIVISION	STATE	COUNTY	CONGR DIST	STATE	COUNTY	CONGR DIST	NAME	LATITUDE (North)	LONGITUDE (West)	REPORT DATE (DAY MO YR)
8 9 10	11 12	13 14 15	16 17	18 19	20 21 22	23 24	25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61	62 63 64 65 66	67 68 69 70 71	72 73 74 75 76 77 78 79 80
ME	DME	001	02				LISBON FALLS DAM	43 59	60 70 03	8 24 JAN 80 0

[13] [14]

IDENTIFICATION *(Continued)*

POPULAR NAME	NAME OF IMPOUNDMENT
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43	44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
	ANDROSCOGGIN RIVER 1

[15] [16] [17] [18] [19] [20]

LOCATION

REGION	BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY – TOWN – VILLAGE	DIST. FROM DAM (mi)	POPULATION
8 9	10 11	12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40	41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68	69 70 71	72 73 74 75 76 77 78 79 80
01	03	ANDROSCOGGIN RIVER	LISBON	0	8340 2

[21] [22] [23] [24] [25] [26] [27] [27A] [27B] [27C] [27D] [27E] [27F]

STATISTICS

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (ft)	HYDRAULIC HEIGHT (ft)	IMPOUNDING CAPACITIES MAXIMUM (acre – ft.)	IMPOUNDING CAPACITIES NORMAL (acre – ft.)	CORPS ENGR. DIST.	OWN.	FED. R.	PRV/FED	SCS A.	VERIFICATION DATE (DA MO YR)	BLANK
8 9 10 11 12 13 14 15 16 17 18 19	20 21 22 23	24 25 26 27 28 29 30 31 32 33	34 35 36 37	38 39 40 41	42 43 44 45 46 47 48 49	50 51 52 53 54 55 56 57	58 59 60	61	62	63	64	65 66 67 68 69 70 71	72 73 74 75 76 77 78 79 80
PG	1980	CH	25	25	1000	800	NED	M	N	N	N		3

[28]

REMARKS

REMARKS
8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
20 - PROJECTED 1980 4

ENG FORM 4474

PART II – INVENTORY OF DAMS IN THE UNITED STATES
(PURSUANT TO PUBLIC LAW 92-367)

See reverse side for instructions.

[1]

STATE	IDENTITY NUMBER
1 2	3 4 5 6 7
ME	0 0 0 4

[29] [30] [31] [32] [33] [34] [35] [36] [37] [38] [39] [40] [41] [42] [43] [44] [45]

STATISTICS

8	D'S HAZ	CREST LENGTH (ft) 10–13	SPILLWAY TYPE 14	SPILLWAY WIDTH (ft) 15–18	SPILLWAY MAXIMUM DISCHARGE (cfs) 19–25	VOLUME OF DAM (CY) 26–34	POWER CAPACITY INSTALLED (MW) 35–40	POWER CAPACITY PROPOSED (MW) 41–46	NO. 47	LOCK 1 LENGTH (ft) 48–51	LOCK 1 WIDTH (ft) 52–53	LOCK 2 LENGTH (ft) 54–57	LOCK 2 WIDTH (ft) 58–59	LOCK 3 LENGTH (ft) 60–63	LOCK 3 WIDTH (ft) 64–65	LOCK 4 LENGTH (ft) 66–69	LOCK 4 WIDTH (ft) 70–71	BLANK 72–79	80
	3	914	U	900			.9	.											5

[46] [47] [48]

MISC. DATA

8	OWNER 9–31	ENGINEERING BY 32–55	CONSTRUCTION BY 56–79	80
	MAX MILLER AND CO.,	INC. LOCKWOOD-GREEM	BOSTON	6

[49] [50] [51] [52]

MISC. DATA *(Continued)*

8	REGULATORY AGENCY: DESIGN 9–25	CONSTRUCTION 26–43	OPERATION 44–61	MAINTENANCE 62–79	80
	NONE	NONE	NONE	NONE	7

[53] [54] [55]

MISC. DATA *(Continued)*

8	INSPECTION BY 9–40	INSPECTION DATE DAY 41–42	INSPECTION DATE MO 43–44	INSPECTION DATE YR 45–46	AUTHORITY FOR INSPECTION 47–79	80
	HALEY & ALDRICH, INC.	09	NOV	79	PUBLIC LAW 92-367	8

[56]

REMARKS

8	REMARKS 9–79	80
	30, 33-ESTIMATED	9

ENG FORM 1 DEC 77 4474A